them in our laboratory to emphasize differences in diffusibility between crystalloid and colloid solutions in studying the nature of protoplasm, to show the method of entrance of solutions into root hairs, and to illustrate a factor in the ascent of sap in stems. The experiments never grow old to the student of inquiring mind.

ORVILLE TURNER WILSON
UNIVERSITY OF CINCINNATI

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

SECTION D—ENGINEERING

THE first session was held in the morning of Thursday, December 28, in the engineering building, Columbia University, Vice-president Dr. Henry M. Howe in the chair, with an attendance of about 65. It was announced that the sectional committee had recommended for election to the general committee for the office of vice-president, Dr. Henry S. Drinker, president of Lehigh University, South Bethlehem, Pa. The following officers were elected by the Section:

Member of Council—Professor F. L. Bishop, of the University of Pittsburgh.

Member of General Committee—Professor D. D. Jackson, of Columbia University.

Member of Sectional Committee—Professor A. E. Burton, of the Massachusetts Institute of Technology.

The program of the session, which was devoted to sanitary engineering, was as follows:

The Treatment of Public Water Supplies: NICHOLAS S. HILL, JR.

The Disposal of Sewage by Dilution in New York Harbor Waters: D. D. JACKSON and R. H. BROWN.

Pure Water and the Public Health: GEORGE A. JOHNSON.

Recent Developments in the Design of Garbage Disposal Plants: GUSTAVE R. TUSKA.

The Sterilization of Tannery Wastes: D. D. JACKSON and A. M. BUSWELL.

The Situation regarding the Main Drainage of New York City: KENNETH ALLEN.

The second session was held on the afternoon of Thursday, December 28, in the assembly hall of the Automobile Club of America, under the joint auspices of the Society for the Promotion of Engineering Education, the Automobile Club of America, the National Highways Association, the National Automobile Chamber of Commerce, and Section D, American Association for the Advancement of Science. This session was devoted to highway engineering education. Mr. William O. Wiley, treasurer of the Society for the Promotion of Engineering Education, was in the chair. The attendance was about 85.

The program of the session was as follows:

The Value of a Training in the Humanities for Engineers: NELSON P. LEWIS.

What is Best in Engineering Education: H. H. HIGBIE.

Education in engineering should be primarily a systematic cultivation of the natural abilities of the individual student, and should be concerned only secondarily with acquiring knowledge of facts or of methods of using them. The greatest services which a college may undertake to perform for its students are:

First: To develop traits and habits which produce a creditable and attractive personal address.

Second: To establish a habit of thinking independently, clearly, accurately, usefully and pleasurably.

Third: To ingrain thoroughly some fundamental principles of science to base thoughts upon.

Fourth: To exalt the personal ideals and morals of a student.

Colleges of engineering commonly attempt to impart other things, which the student is not likely to assimilate, namely:

1. Experience and judgment in the applications of scientific principles to practical problems.

2. Special knowledge, expertness or speed in any particular branch of science or art.

3. Equipment of knowledge adequate for any demand without some measure of ingenuity or adaptive ability on the students' part.

Any notable improvements in the functioning of an engineering college will depend upon:

1. Personality, interest, enthusiasm of the teachers and their contact with the students.

2. More general and serious study of educational problems by teachers of engineering.

3. Greater adaptability of the educational system to the individual student.

Criticisms and suggestions are made concerning the teaching of English and foreign languages, specialized or professional courses and mathematics.

Essential Qualifications of Highway Engineers for State, County and Municipal Departments: E. A. STEVENS.

[1] New York, December 28–29, 1916.

The Objects of the Educational Campaign of the National Automobile Chamber of Commerce: Alfred Reeves.

Highway Engineering Electives in the Fourth Year of Civil Engineering Courses: Hector J. Hughes.

The demand for skilled highway engineers raises the question whether the engineering schools are providing the best training possible in this field; if not, should the situation be met by: (1) Specialized post-graduate courses; or (2) by specialized undergraduate courses in highway engineering; or (3) by offering a limited amount of specialized options in the fourth year? Post-graduate work following a good course in fundamentals offers a solution for those few men who can give the additional time and money, but most engineering students can not do so, and this limits the problem chiefly to the four-year courses. In the past, specialized courses have been organized to meet similar needs in other fields; but experience shows that training in the fundamentals is more important than specialized studies. Specialized four-year courses in highway engineering may make the students more successful for a few years after graduation, but the narrowness of such training is likely to limit their usefulness and their opportunities. It appears to be possible to provide in a well rounded four-year program the fundamentals of civil engineering and at the same time to offer small groups of electives in several of the most important special fields of civil engineering.

The Need for Highway Engineering Courses in Civil Engineering Curricula of Western Universities: T. R. Agg.

Limitations of Field and Laboratory Work in Highway Engineering in Civil Engineering Curricula: C. S. Farnham.

Subjects recommended for Inclusion in Civil Engineering Courses to qualify Graduates to enter the Field of Highway Engineering: Arthur H. Blanchard.

The papers and discussions presented at this session will be published in full in the *Bulletin* of the Society for the Promotion of Engineering Education.

The third session was held on the evening of Thursday, December 28, in the assembly hall of the Automobile Club of America under the joint auspices of the Automobile Club of America, the National Highways Association, the Motor Truck Club of America, the National Automobile Chamber of Commerce, the Citizens' Street Traffic Committee of Greater New York, and Section D, American Association for the Advancement of Science, Vice-president Dr. Henry M. Howe was in the chair. This session was devoted to highway engineering, and the attendance was about 130.

The program of the session was as follows:

The Interrelations of Seaport, Railroad and Highway Terminals: Calvin Tomkins.

Highways formerly were and railroads now are the principal land factors in transportation.

Definition of port terminal service.

Growing importance of motor trucks and highways as feeders to railroads and waterways—and for short hauls.

Breakdown of transportation at city terminals a consequence of difficulty in adapting and expanding these terminals to changing conditions.

Necessity for segregating terminal charges from transportation charges in order to obtain revenue to finance modern terminals.

Large proportion of railroad capital unprofitably invested in terminal properties which should be made public and integrated as administrative units.

Terminal reorganization involving parity of opportunity for all carriers and shippers and real-estate owners, interferes with vested interests based on bad terminal practises. Improvements are consequently delayed.

Rotary Traffic, Accomplishments and Possibilities: William P. Eno.

In 1903, the "rotary system" was suggested for Columbus Circle and put in use in 1905. In 1907 it was adopted at the Arc de Triomphe in Paris. Now it is in effect at all circles in all cities where there is any intelligent attempt to regulate traffic.

The "rotary system" could be made to replace the "block system" at simple intersections in all cases where there is sufficient turning space. It has been adopted in other cities but New York has so far failed to profit by it. Its installation on Fifth Avenue would largely eliminate blockades and would add at least 25 per cent. and possibly as much as 50 per cent. to the traffic capacity of the street. A fair trial could be made at such slight cost that the saving in one day by its operation would pay for the trial. It should therefore be put into effect without unnecessary delay and the "Go Go" semaphores should be discontinued as they are worse than nothing.

Recent Investigations of Tractive Resistance to Motor Trucks: A. E. Kennelly and O. R. Schurig.

Printed in Science, April 6, p. 341.

Speed Governors for Motor Trucks: THEODORE DOUGLAS.

There are various types of governors available of which about 95 per cent. are of the centrifugal variety. The constant-engine-speed governor ties up from 20 per cent. to 50 per cent. of the power capacity of the engine and sacrifices both gasoline and engine efficiency. The constant-vehicle-speed governor regulates only the vehicle speed and sacrifices the engine through allowing a prohibitive speed on low gears, and no control at all in idling. It is shown that the *ideal governor* would be a combination of the constant-engine-speed and the constant-vehicle-speed governors. A governor of this combination type is now available in the industry.

This governor may be broadly described as a combination of two-speed controls operating a single centrifugal unit and actuating a single valve. This is accomplished through the employment of two springless pawl clutches so designed that each may overrun the other. Whether the speed from the engine or from the vehicle is the higher speed, that speed will engage the centrifugal unit and close the valve.

By the use of the combination type governor, truck efficiencies have been largely increased, and a perfect automatic control has been supplied.

Factors controlling Maximum Overall Dimensions of Motor Trucks: ALFRED F. MASURY.

Traffic Census Analysis: WILLIAM H. CONNELL.

In order to work out a suitable highway design, it is necessary to make a study of the traffic conditions, and upon the collection of adequate data and its careful analysis may be based: (*a*) the plan of a highway with respect to its lines, grades, widths and location of roadways, footways and lawn areas; (*b*) the design of a pavement surface and base best suited to the traffic requirements; (*c*) an estimate of the probable relation between traffic service and maintenance costs; (*d*) the character and time of cleaning best suited to the prevailing types of traffic; and (*e*) the physical regulation of traffic with respect to the direction of flow, crossings, parking areas, safety islands and zones, and safety and regulating signals.

The several lines of investigation which are necessary to a comprehensive traffic study may be indicated as follows: (*a*) the survey, which determines the nature of the existing physical and other conditions influencing or relating to the traffic; (*b*) the census, which records the quantity, character and weight of traffic; and (*c*) the planning, through which it is sought to develop a more consistent relation between traffic requirements and traffic provision.

In most traffic census, it has been the general practise to consider "ton of traffic per foot width of pavement" as a proper unit. It would seem that the most logical and satisfactory unit of traffic measurement would be the "ton-mile" or its multiples per foot of maximum travelled width of pavement.

The Most Satisfactory and Economical Pavement for Parkway Drives: SAMUEL WHINERY.

Present Status of Preliminary Location and Mapping of National Highways proposed by the National Highways Association: CHARLES HENRY DAVIS.

Possible Variations of Physical Properties of Rock from One Quarry: CHARLES P. BERKEY.

Stone and Concrete Foundations from the Standpoint of Efficiency and Economy: GEORGE C. WARREN.

The words "Efficiency and Economy" each in their broadest sense mean practically the same thing and the same as the word "best," when considered in its broadest sense of "all things considered."

There is no one "best" for all conditions and an engineer who would recommend any one type of pavement surface or foundation as universally best, would be like an architect who specified one class of building material as best for all buildings, *i. e.*, a "man of one idea."

In determining the character of foundation best suited for any particular case, the engineer or road-builder should give most careful consideration to the character of subsoil, traffic, wearing surface to be laid on the foundation, and climatic conditions.

Block pavements of all kinds should be almost universally laid on concrete foundations. Monolithic bituminous pavement surfaces depending on stability of the surface and local conditions outlined above, may be laid on either rolled broken stone or concrete foundations.

Concrete includes any dense combination of mineral aggregates in which the coarser sizes predominate artificially bound together with either Portland, bituminous, or any other type of cement.

Generally speaking, broken-stone foundation is adapted for cases where the rolled subgrade is of a character of material which can be solidly compressed. It has been found that sand provides a good sub-base provided the sand is sprinkled during the rolling of the broken stone, thus providing a sub-base condition like damp sand on the beach.

Concrete foundations should be used on weak subsoil of clay, etc. Portland cement concrete roads and foundations crack, causing corresponding cracks in the pavement surface, which is retarded by the use of either broken stone or bituminous concrete foundation. Bituminous pavement surfaces are more liable to creep on Portland cement concrete than on broken stone or bituminous concrete foundations, as in the latter cases the surface and foundation are firmly united to each other. Portland cement concrete foundations should be used where a maximum rigidity is essential.

Present Status of Bituminous Surfaces on Gravel Roads: John R. Rablin.

Value of Physical Tests on Bituminous Aggregates: Prevost Hubbard.

Proportions of Ingredients of Bituminous Mortars Used for Fillers: Phillip P. Sharples.

Bituminous mortars used for fillers in block pavements have been used in the United States of America since 1913. These fillers consist of mixtures of coal tar pitch and sand, or asphalt and sand. Specifications for both kinds were adopted at the 1916 meeting of the American Society of Municipal Improvements.

These bituminous mortars are particularly well adapted for use in filling the joints of stone block, brick, lug wood block and Durax pavements. Observation shows that the asphalt-sand mastic does not fill the joints as well as the pitch-sand mortar, owing to the higher melting point of the former and its lower adhesive value.

Summary.—Those bituminous mortar fillers that have given trouble to date have done so because not sufficient sand was originally mixed with the bitumen. A fine sand gives much better results than a coarse sand, and more of it can be introduced in the mastic. By properly heating and applying, a mastic with equal parts, by volume, of sand and bitumen can be forced into the joints of block pavements. For special conditions, special grades of bitumens must be used. Hand mixing is cheaper than machine mixing, and as good. The pouring method should be entirely dispensed with and the flushing and squeegeeing method substituted.

Present Status of Physical Tests for Granite Blocks: C. D. Pollock.

This paper gives the progress made in tests of granite for paving blocks and reviews the changes made in such tests in standard specifications which have been in very general use.

Even the latest tests are far from ideal, as the conditions which prevail in the tests do not approximate those which exist in actual traffic on the pavements.

Engineers are now studying this question and undoubtedly will work out some tests which will more nearly conform to the wear and tear of the traffic on the granite block pavements in the street.

The service test at the present time is the only sure and reliable test.

Joint Fillers for Granite Block Pavements: Herman H. Schmidt.

In this paper the development of the granite block pavement is traced from the first granite pavement laid which resembles our modern granite pavement, up to the present highly improved granite pavement, as laid in our large cities.

A detailed statement of the requirements of ideal joint fillers is given, followed by a discussion of the various joint fillers used and available. In this discussion the defects in each are pointed out, and the writer suggests what in his estimation would be an ideal joint filler.

There is also a brief discussion of methods for applying joint filler, and mention is made of the character of the cushion course which will give best results.

The writer's conclusion is that with slight changes in the methods of work and improvement in the character of joint filler, granite pavement will have reached the highest state of development of which it is capable.

The Real Sources of Trouble in Brick Pavements: Maurice B. Greenough.

The most common imperfections in brick pavements are caused by non-enforcement of adequate specifications reflecting the best procedure of modern methods. One hundred per cent. construction is not possible of attainment under some specifications in force which are indefinitely worded and incomplete. Few imperfections are caused by brick of poor quality. The American Society for Testing Materials has adopted procedures which, if followed, insure securing the required degree of quality in the brick. Monolithic construction, while not a panacea for all brick pavement troubles, eliminates the hazards of a faultily prepared sand cushion and affords a large measure of protection against most brick pavement imperfections.

A. H. Blanchard,
Secretary

(To be concluded)